REMARKS

Claims 1-18 are pending in this application. In the Office Action, claims 8-16 were withdrawn from consideration. By this Amendment, claims 1-3 and 7 are amended, and claims 17 and 18 are added. No new matter is added.

I. The Claims Define Patentable Subject Matter

The Office Action rejects claims 1-5 and 7 under 35 U.S.C. §102(b) as being anticipated by Sakamoto, JP2000-174044. The rejection is respectfully traversed.

Sakamoto fails to disclose the step of preparing a wiring substrate having a base substrate on which are formed interconnecting lines, apart from a semiconductor chip, as recited in claims 1 and 18.

Sakamoto discloses a liquefied closure resin constituent formed into a B-staged resin by heat-treating the wafer where the liquefied closure resin constituent was applied. However, Sakamoto fails to disclose a wiring substrate having a base substrate with interconnecting lines.

Further, Sakamoto fails to disclose melting the base substrate while bumps provided on the semiconductor chip are pressed into the base substrate, as recited in claims 1 and 18.

Sakamoto discloses diced semiconductor elements bonded to a board, and at the same time, the B-staged resin composition is heat-fluidized so that the composition is cooled. However, Sakamoto fails to disclose melting the base substrate while pressing the bumps and semiconductor chip together. In fact, Sakamoto fails to disclose or even mention the process of pressing the bumps and semiconductor chip together since the thermosetting liquid sealing resin composition is B-staged. What Sakamoto teaches is creating (para. [0009] of the attached computer translation) a semi-conductor device with solder bumps and a resin that coats the semi-conductor device which is then mounted to a substrate by melting the solder bumps and the resin which flows to fill the gap between the semi-conductor device and the

substrate during application of pressure (para. [0013]). Accordingly, Sakamoto fails to disclose melting the base substrate while bumps provided on the semiconductor chip are pressed in, as recited in claims 1 and 18 as presented, in fact, teaches away from the invention.

Sakamoto also fails to disclose the electrically connecting the bumps to the interconnecting lines, as recited in claims 1 and 18.

Sakamoto merely discloses a plurality of semiconductor elements having bumps for electrical connection to the board. That is, although Sakamoto discloses bumps for electrical connection to the board, Sakamoto fails to disclose any interconnecting lines with connecting portions which are electrically connected with the bumps. By providing the substrate with interconnecting lines formed on one surface of the base substrate, it becomes simple to mount the semiconductor chip on both sides.

Because Sakamoto does not literally disclose the claimed invention, it cannot provide the basis for rejection under 35 U.S.C. §102. Thus, it is respectfully requested that the rejection be withdrawn.

The Office Action rejects claim 6 under 35 U.S.C. §103(a) as being unpatentable over Sakamoto in view of U.S. Patent 6,208,525 to Imasu et al. (hereinafter "Imasu"). The rejection is respectfully traversed.

As discussed above, Sakamoto neither discloses nor suggests the claimed invention as found in claim 1, the independent claim from which the rejected claim depends. Imasu fails to overcome the noted deficiencies of Sakamoto. It is respectfully requested that the 35 U.S.C. §103 rejection be withdrawn.

For at least these reasons, Applicant respectfully submits that Sakamoto and Imasu, individually or in combination, fail to disclose or render obvious the features recited in independent claims 1 and 18. Claims 2-7 and 17, which depend from independent claim 1 are

likewise distinguished over the applied art for at least the reasons discussed, as well as for the additional features they recite. Reconsideration and withdrawal of the rejections are respectfully requested.

II. Conclusion

In view of the foregoing, it is respectfully submitted that this application is in condition for allowance. Favorable reconsideration and prompt allowance of claims 1-18 are earnestly solicited.

Should the Examiner believe that anything further would be desirable in order to place this application in even better condition for allowance, the Examiner is invited to contact the undersigned at the telephone number set forth below.

Respectfully submitted,

James A. Oliff
Registration No. 27,075

David J. Cho
Registration No. 48,078

JAO:DJC/brc

Attachment:
Translation of Japanese Patent 2000-174044

Date: August 20, 2003

OLIFF & BERRIDGE, PLC
P.O. Box 19928
Alexandria, Virginia 22320
Telephone: (703) 836-6400

DEPOSIT ACCOUNT USE AUTHORIZATION
Please grant any extension necessary for entry;
Charge any fee due to our Deposit Account No. 15-0461

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2000-174044

(43)Date of publication of application : 23.06.2000

(51)Int.Cl. H01L 21/56
H01L 21/60

(21)Application number : 10-348668

(22)Date of filing : 08.12.1998

(71)Applicant : SUMITOMO BAKELITE CO LTD

(72)Inventor : SAKAMOTO YUJI

(54) ASSEMBLY OF SEMICONDUCTOR ELEMENT

(57)Abstract:

PROBLEM TO BE SOLVED: To reduce the processing time by applying a thermosetting liquid sealing resin composition to a wafer, B-staging the wafer, dicing the resultant wafer into semiconductor elements, and bonding the semiconductor elements to a board and at the same time heat-fluidizing the B-staged resin composition so that the composition is cooled.

SOLUTION: A thermosetting liquid sealing resin composition, which is prepared by weighing an epoxy resin, diaminodiphenylsulfone and a filler, evenly dispersing them by means of roll-kneading or the like, and further subjecting them to defoaming, is applied to a wafer on which a plurality of semiconductor elements having bumps for electrical connection to a board are formed. After the thermosetting liquid sealing resin composition is B-staged, the wafer is diced into small pieces. The diced semiconductor elements are thereafter bonded to a board, and at the same time, the B-staged resin composition is heat- fluidized so that the composition is cooled. As a result of this process, the processing time can be reduced.

LEGAL STATUS

[Date of request for examination] 06.06.2001

[Date of sending the examiner's decision of rejection] 10.02.2003

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

CLAIMS

[Claim(s)]
[Claim 1] 1) the wafer with which many semiconductor devices which have a bump for carrying out electric junction with a substrate were formed -- B- a stage -- the process which applies the thermosetting liquefied closure resin constituent [-izing / a constituent] -- 2) The dicing of the process and 3 this wafer which form this liquefied closure resin constituent into B-stage is carried out. The assembly method of the semiconductor device characterized by the bird clapper from the process which piece[of an individual]-izes a semiconductor device, and the sticking-by-pressure process by carrying out a heating flow of the resin constituent which joined to the semiconductor device and substrate which were piece[of 4 individuals]-ized, and was simultaneously formed into B-stage, and cooling.
[Claim 2] The assembly method of a semiconductor device according to claim 1 that thermosetting liquefied closure resin constituents are the spherical inorganic filler 0.5 micrometers to 12 micrometers and whose maximum droplet size are 50 micrometers or less, the epoxy resin which 2 weight per epoxy equivalents are 200 or more, and contains the epoxy group of two or more organic functions, and a thermosetting [which comes to contain 3 diamino diphenyl sulfone] liquefied [one mean particle diameter] closure resin constituent.
[Claim 3] The assembly method of the semiconductor device according to claim 1 characterized by performing the process which applies a thermosetting liquefied closure resin constituent by the spin coat method.
[Claim 4] The assembly method of the semiconductor device according to claim 1 or 2 which is the thermosetting liquefied closure resin constituent with which a thermosetting liquefied closure resin constituent comes to contain plasticity polymer.

[Translation done.]

*NOTICES *

1. This document has been translated by computer.So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the assembly method of the semiconductor device joined to a substrate by the bump junction method.
[0002]
[Description of the Prior Art] The flip chip mounting method appeared from a demand called high integration of IC chip, and densification and the miniaturization of an IC package. This mounting method is enabling small and thin shape-ization by carrying out electrical installation of not connection but old IC chip front face and the old printed circuit board by wire bonding by the metal bump. However, since the coefficients of thermal expansion of a chip, a printed-circuit board, and solder differ, heat stress occurs at the time of a cold energy impact test. Heat stress concentrates on the metal bump of the corner neighborhood distant especially from the center of a chip locally. For this reason, a crack arises at joint grade and the operation reliability of a circuit falls greatly.
[0003] Then, closure by liquefied pouring closure under-filling material is performed from the purpose which eases heat stress. However, since the method of pouring under-filling material into the crevice between a chip and a printed-circuit board, hardening, and closing is taken, this method has a complicated process and also requires cost. Furthermore, in the case of such a semiconductor device, a wafer production process, the electrical circuit formation formation process to a wafer top, the piece-ized process of an individual, the bump formation process, the bump junction process, and the under-filling closure process were required, and since delivery cost started that a manufacturing company differs from works in many cases as for the process here, it had a problem.
[0004] Then, the method of having been proposed not forming and piece[of an individual]-izing an electrical circuit to a wafer, but forming a bump and piece[of an individual]-izing after that was invented. This method can also make a semiconductor device with a bump from wafer manufacture with the line of a part, and the cost of an element may fall sharply. However, even if it is this method, in order to raise reliability, an under-filling closure process is required, and the problem reflected in cost remained.
[0005]
[Problem(s) to be Solved by the Invention] this invention is made in order to solve the problem like the new erector of the above of a semiconductor device with a bump. The place made into the purpose is to offer the assembly method of the semiconductor device which could aim at large shortening of a manufacturing process, and was excellent in reliability.
[0006]
[Means for Solving the Problem] namely, the wafer with which many semiconductor devices which have a bump for carrying out electric junction of this invention with one substrate were formed -- B- a stage -- the process which applies the thermosetting liquefied closure resin constituent [-izing / a constituent] -- 2) The dicing of the process and 3 this wafer which form this liquefied closure resin constituent into B-stage is carried out. It is the assembly method of the semiconductor device characterized by the bird clapper from the piece[of an individual]-ized process, and the sticking-by-pressure process by carrying out a heating flow of the resin constituent which joined to the semiconductor device and substrate which were piece[of 4 individuals]-ized, and was simultaneously formed into B-stage, and cooling.
[0007]
[Embodiments of the Invention] this invention is explained in detail. After making a bump form in many semiconductor devices by which the electrical circuit was first formed on the wafer, a thermosetting liquefied closure resin constituent is applied to the whole wafer of a circuit forming face. The method of applying a thermosetting

liquefied closure resin constituent can use the method learned from the former, such as printing, dispensing, a spin coat, and an imprint. The spin coat method is desirable in it. This is because it is easy to control thickness, the resin constituent which remains on a bump can be lessened as much as possible and a poor contact is not started at the time of junction.

[0008] the thermosetting liquefied closure resin constituent used by this invention -- B- a stage -- it is the resin constituent [-izing / a constituent] After "the formation of B-stage is possible" as used in the field of this invention applies a resin constituent, hardening can be advanced at low temperature and it can change into a tuck free-lancer's state, and a reaction hardly advances one month or more by the storage temperature (usually ordinary temperature), but it has the property which is fused and pasted up at the temperature at the time of bump junction and which can carry out things. There are an epoxy resin / a dicyandiamide system, an epoxy resin / aromatic-amine system, etc. as an example of the resin constituent which has such a property. The mechanism uses the reactivity of active hydrogen and an epoxy resin. For example, although a primary amine reacts easily below about 120 degrees C in the case of an epoxy resin/aromatic amine, in order to make the secondary amine which next remains react, it is necessary to apply heat at least 140 degrees C or more. This is for reactivity to fall in connection with steric hindrance. Especially the epoxy resin / diamino diphenyl sulfone system are suitable in it as a resin system which has the aforementioned property.

[0009] In order to use as a closure use of a semiconductor device, high reliability is required for the thermosetting liquefied closure resin constituent used by this invention. In order to bring especially water resistance and coefficient of linear expansion close to an adherend, it is desirable to add an inorganic filler. At the time of junction, since the fluidity is required, the configuration has a desirable spherical. Furthermore, as for the size, it is desirable that mean particle diameters are [the range of 0.5 to 12 micrometers and a maximum droplet size] spherical fillers 50 micrometers or less. The fluidity of the liquefied closure resin constituent which is fused at the time of bump junction as a mean particle diameter is less than 0.5 micrometers and which was formed into B-stage becomes insufficient, the effusion (fillet) of the resin constituent other than a chip becomes inadequate, and there is fear of a fall of the reliability by the shortage of an adhesive property. Moreover, when the mean particle diameter exceeded 12 micrometers and a filler remains a liquefied closure resin constituent on a bump at the time of an application, there is a possibility of starting a poor contact, at the time of next bump junction. Moreover, about a maximum droplet size, generally, since a bump's height is 100 micrometers or less, you have to make application thickness of a liquefied closure resin constituent at least below into the bump's height. When a maximum droplet size exceeds 50 micrometers, there is a possibility of dispersion becoming large at application thickness and causing poor junction at the time of bump junction.

[0010] Although there are nitriding aluminum, an alumina, a silica, etc., the field of heat leakage nature and cost to its silica particle is desirable, and if the kind of inorganic filler used by this invention is low radiation nature, it is more desirable. Although a configuration has the shape of a globular shape, the letter of crush, and flakes etc., since reduction-ization of coefficient of linear expansion is attained by high restoration-ization of a filler, a spherical thing is required. The addition of a spherical inorganic filler has 50 - 80 desirable % of the weight to all constituents. Since the coefficient of linear expansion of moisture resistance or a hardened material will become large if it is less than 50 % of the weight, the viscosity of the constituent obtained as a result will become high too much if 80 % of the weight is exceeded, and flowability gets worse, it is not desirable.

[0011] B- used by this invention -- a stage -- it is material with especially desirable an epoxy resin / diamino diphenyl sulfone system in the thermosetting liquefied closure resin constituent [-izing / a constituent] However, since a resin constituent layer exfoliates at the time of dicing or is missing at it if B-stage is formed by the system which added the filler to the epoxy resin / diamino diphenyl sulfone, as an epoxy resin, a weight per epoxy equivalent is 200 or more, and it is desirable that an epoxy group is [the thing of two or more organic functions] a principal component. When a weight per epoxy equivalent is smaller than 200, the resin after the formation of B-stage is weak, and it is for exfoliation and a chip to arise at the time of dicing. Moreover, since it is used for closure of a semiconductor, as for the ionicity impurity, especially adding-water resolvability chlorine of an epoxy resin, it is desirable that it is 1000 ppm or less. Furthermore, since the exfoliation at the time of dicing and a chip are prevented, plasticity polymer can also be added to the liquefied closure resin constituent used by this invention.

[0012] The manufacture method of the thermosetting liquefied closure resin constituent used by this invention first carries out weighing capacity of an epoxy resin (it is made to dissolve with a solvent in a solid case), a diamino diphenyl sulfone, and the filler, and they are made it to carry out uniform distribution using roll kneading etc. Furthermore degassing is carried out and it produces. Moreover, even if it uses additives, such as the catalyst for promoting other resins and reactions other than the aforementioned indispensable component if needed, a diluent, a

)igment, a coupling agent, a flame retarder, a leveling agent, and a defoaming agent, it does not interfere with this iquefied closure resin constituent.

0013] Next, a liquefied closure resin constituent is formed into B-stage by heat-treating the wafer with which the iquefied closure resin constituent was applied. The method is performed by heat-treating at temperature sufficiently ower than a curing temperature, as the definition with the "possible" formation of B-stage of this invention described. Next, a dicing process can be performed by the usual method learned conventionally. Finally a sticking-by-pressure process is explained. If a solder bump is taken for an example, the temperature of 150 degrees C or more and a load will be added, and the pressure welding of the solder ball will be carried out to a substrate. The resin constituent then formed into B-stage dissolves, and it is filled up with the gap of an element and a substrate. It is joined to a substrate and conductive element also completes closure in the second half of cooling. In addition, in order for a liquefied closure resin constituent to make more sufficient property discover, it is also possible to supply to oven etc. and to carry out a postcure to it.

[0014]

[Example] Let the example 1 bisphenol A epoxy resin (weight per epoxy equivalent 250) 100 weight section be a solvent. The varnish 100 section dissolved in the butyl-cellosolve acetate of 30 weight sections, It is gamma as the diamino diphenyl SURUFONN 19.1 weight section and adhesion grant material. - Glycide oxy-trimethoxysilane 1 weight section silicone system defoaming-agent 1 weight section, The 2 phenyl 4 ethyl imidazole 0.5 weight section was carried out as a hardening accelerator, weighing capacity of the spherical silica (0.8 micrometer [of mean particle diameters], 20 micrometers of maximum droplet sizes) 144 weight section was carried out as a filler, 3 rolls performed vacuum degassing processing after kneading / distribution, and the liquefied closure resin constituent was produced. The produced liquefied closure resin constituent, and the resin constituent was uniformly applied on the wafer using the spin coater. [the wafer (thickness of 350 micrometers) with which the solder bump with a height of 70 micrometers was formed] After that, it heated for 3 hours and 80degrees C of B-stage-ization were performed. Final application thickness was controlled to be set to 60 micrometers. Next, the wafer was piece[of an individual]-ized for every element using the dicing saw (6x6mm of chip sizes). Exfoliation and the crack were not looked at by the liquefied closure resin constituent layer formed into B-stage near the cut side. Next, the element was stuck to the organic substrate by pressure at the temperature of 150 degrees C. It was able to complete in 1 - 2 seconds, and resin constituent closure was able to be performed simultaneously with junction to the substrate of a solder ball. Furthermore, after forming B-stage, what was saved in ordinary temperature for three months was able to be joined similarly, and resin constituent closure and junction were able to be simultaneously performed like the first stage.

[0015] Resin constituent characteristic test (1) Bond strength: As an organic substrate. The polyimide for passivation films (Sumitomo Bakelite Co., Ltd. CRC-6050) was applied to the wafer front face for the thing in which the solder resist (PSR-4000/CA- 40) was formed on the substrate made from bismaleimide-triazine (BT) resin, and further, the coat was carried out, 80 degrees C, the liquefied closure resin constituent was covered for 3 hours, and was formed into B-stage by the spin coat method, and it applied to the thickness of 60 micrometers, and, finally cut into the 6x the silicon chip was carried in the form where a polyimide application side and a liquefied closure resin constituent face each other, and it came out, 150 degrees C was hardened in sticking by pressure and also 150 degrees C, and 60 minutes, it considered as the test piece, and the die share intensity in 240 degrees C of this thing was measured by BT100 made from DAGE Moreover, moisture absorption processing with a 85% temperature [of humidity] of 85 degrees C was performed for this test piece for 72 hours, die share intensity was measured similarly, and it considered as the adhesion after moisture absorption processing. Moreover, the chip which applied the liquefied closure resin constituent formed into B-stage was kept for three months in ordinary temperature, and the same experiment was conducted. Those results are shown in Table 1.

[0016] Let the example 2 bisphenol A epoxy resin (weight per epoxy equivalent 250) 100 weight section be a solvent. The varnish 100 section dissolved in the butyl-cellosolve acetate of 30 weight sections, It is gamma as the diamino diphenyl SURUFONN 19.1 weight section and adhesion grant material. - Glycide oxy-trimethoxysilane 1 weight section silicone system defoaming-agent 1 weight section, It is a spherical silica (0.8 micrometers of mean particle diameters) as the 2 phenyl 4 ethyl imidazole 0.5 weight section and a filler as a hardening accelerator. Weighing capacity of 20 micrometer 159 weight section of maximum droplet sizes and the butadiene acrylonitrile copolymer (CTBN1300X9:Ube Industries make) 10 section which is a both-ends carboxylic acid as flexible grant material further is carried out. with 3 rolls After kneading / distribution, Vacuum degassing processing was performed and the liquefied closure resin constituent was produced. The produced liquefied closure resin constituent, and the resin constituent was uniformly applied on the wafer using the spin coater. [the wafer (thickness of 350 micrometers) with which the solder bump with a height of 70 micrometers was formed] After that, it heated for 3 hours and 80degrees C of B-stage-

zation were performed. Final application thickness was controlled to be set to 60 micrometers. Next, the wafer was piece[of an individual]-ized for every element using the dicing saw (6x6mm of chip sizes). exfoliation and the crack were not looked at by the liquefied closure resin constituent layer boiled and formed into B-stage near the cut side Next, the element was stuck to the organic substrate by pressure at the temperature of 150 degrees C. It was able to complete in 1 - 2 seconds, and resin constituent closure was able to be performed simultaneously with junction to the substrate of a solder ball. Furthermore, after forming B-stage, what was saved in ordinary temperature for three months was able to be joined similarly, and resin constituent closure and junction were able to be simultaneously performed like the first stage. Moreover, the bond strength was measured like the example 1.

[0017] the same filler as example of comparison 1 example -- solid-content conversion -- 60wt(s)% -- what joined the element of the same composition as an example to the substrate beforehand using the under-filling material (Sumitomo Bakelite CRP- 4000) included (the same as an example) was laid on the 80-degree C hot plate, it applied around the chip in the state, and the gap of a chip and a substrate was filled up with the resin constituent The injection time was 1 minute. Furthermore, 150 degrees C was stiffened in oven for 1 hour. Moreover, the bond strength was measured like the example. The result is shown in Table 1.

[0018] Let the example of comparison 2 bisphenol A epoxy resin (weight per epoxy equivalent 180) 100 weight section be a solvent. The varnish 100 section dissolved in the butyl-cellosolve acetate of 30 weight sections, It is gamma as the diamino diphenyl SURUFONN 26.5 weight section and adhesion grant material. - Glycide oxy-trimethoxysilane 1 weight section silicone system defoaming-agent 1 weight section, The 2 phenyl 4 ethyl imidazole 0.5 weight section was carried out as a hardening accelerator, weighing capacity of the spherical silica (0.8 micrometer [of mean particle diameters], 20 micrometers of maximum droplet sizes) 155 weight section was carried out as a filler, 3 rolls performed vacuum degassing processing after kneading / distribution, and the liquefied closure resin constituent was produced. The produced liquefied closure resin constituent, and the resin constituent was uniformly applied on the wafer using the spin coater. [the wafer (thickness of 350 micrometers) with which the solder bump with a height of 70 micrometers was formed] After that, it heated for 3 hours and 80degrees C of B-stage-ization were performed. Final application thickness was controlled to be set to 60 micrometers. Next, the wafer was piece[of an individual]-ized for every element using the dicing saw (6x6mm of chip sizes). Since many ablation and cracks were looked at by the liquefied closure resin constituent layer formed into B-stage near the cut side, subsequent evaluation was stopped.

[0019]

[Table 1]

	実施例1	実施例2	比較例1	比較例2
ダイシング性	良好	良好	—	剥離、クラックあり
接着強度1	12	13	12	—
接着強度2	11	12	10	—
接着強度3	12．2	12．6	—	—
接着強度4	11．8	12．2	—	—

[0020] Dicing nature: It is intensity (unit : kgf / 6x6mm chip) at the time of the heat immediately after state bond-strength 1:hardening of the resin constituent layer formed into B-stage when carrying out the dicing of the wafer shown in the example.

It is intensity (unit : kgf / 6x6mm chip) at the time of the heat after 2:85 degrees C of bond strengths, 85%R, and 72-hour processing.

Bond-strength 3: After keeping it for B-stage-ized back ordinary temperature (25 degrees C) three months, the bond strength 1 was tested.

Bond strength 4: After keeping it for B-stage-ized back ordinary temperature (25 degrees C) three months, the bond strength 2 was tested.

[0021]

[Effect of the Invention] If the assembly method of this invention is followed, compared with the method of filling up the piece element of an individual with under-filling material, a manufacturing process can be shortened sharply, and resin formation of a up to [a wafer] will also become possible as part of a wafer process. Furthermore, as shown by the example, B-stage-ized possible resin constituent of this invention does not have the conventional under-filling material and inferiority in a bond strength, and a hatchet industrial merit is large in the mothball in a process being possible the middle.

Translation done.]